**Electrical Principles and Technologies**

**Unit D**

**Topic 1**  
**Electric Charges**  
- Producing Charges  
- Making Sense of Electrical Charges  
- Conductors, Insulators, and In-Between  
- Neutralizing Unbalanced Charges  
- Preventing Electrostatic Buildup

**Topic 2**  
**Electricity Within a Circuit**  
- Circuit Elements and Diagrams  
- Basic Circuit Symbols  
- Measuring Current  
- Measuring Voltage  
- Rivers of Electricity

**Topic 3**  
**Resisting the Movement of Charge**  
- Calculating Resistance  
- Model problem  
- Resistors  
- Variable Resistors  
- Types of Circuits  
- House Wiring

**Topic 4**  
**The Energy Connection**  
- Electricity and Heat  
- Electricity to Motion  
- Motion to Electricity  
- Electricity to Light  
- Light to Electricity

**Topic 5**  
**Portable Power**  
- Electrochemical Cells  
- Fuel Cells  
- Types of ‘dry’ cells

**Topic 6**  
**Generators and Motors**  
- Electricity to Magnetism  
- Electromagnets  
- Magnetism to Electricity  
- What’s in a Generator?  
- DC Generators  
- Electric Motors: Electric to Mechanical Energy  
- DC Motors  
- AC Motors

**Topic 7**  
**Electricity in the Home**  
- Transmission of Electricity through the Power Grid  
- From the Grid into Your Home  
- Home Wiring  
- Digital Devices  
- Measuring Electric Power  
- Model Problem  
- Paying For Electric Energy  
- Model Problem  
- Power Rating  
- Electric Devices and Efficiency  
- Incandescent Bulbs  
- Halogen Bulbs  
- Fluorescent Tubes  
- Model Problem  
- Home Electric Safety  
- Electric Safety Outdoors

**Topic 8**  
**Electricity Production and the Environment**  
- Electric Energy from Burning Fuels  
- Fossil Fuels Affect Land and Air  
- Electric Energy from Flowing Rivers  
- Energy from Atomic Reactions  
- Heating the Environment  
- Electrical Technology and Society  
- Cogeneration  
- Reducing the Energy Wasted by Devices  
- Alternative Energy Sources  
- Electrical Energy Sources and Alternatives
Topic 1 ( pgs. 266-271 )

Explain how an object becomes ‘charged’.

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What is the difference is between a ‘positive charge’ and a ‘negative charge’?

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Describe and illustrate the ‘Laws of Electric Charge’.

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Explain the difference between conductors, semi-conductors and super conductors. How are they different from insulators?

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How can you prevent an electric discharge from doing harm to people or expensive electrical equipment?

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_______________________________________________________________________________
List and give examples of the four basic elements or types of components in a simple circuit.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>__________</td>
<td>__________________</td>
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</tbody>
</table>

Identify or illustrate the electrical circuit component or symbol in the table.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>wire</td>
<td>__________</td>
<td></td>
</tr>
<tr>
<td>cell</td>
<td>M</td>
<td>variable resistor</td>
</tr>
<tr>
<td>lamp</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V</td>
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</tbody>
</table>
Illustrate how an ammeter, a galvanometer, and a voltmeter are included in a schematic drawing.

What do each of these electrical devices measure?

Ammeter ____________________ Voltmeter ____________________ Galvanometer ______________

All forms of energy are measured in joules (J). When describing the electrical energy in a circuit, different units are used. What units are used in each case?

Current _________________ Voltage _________________

Describe and Illustrate the difference between Current, and Voltage using a MODEL

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**Topic 3** (pgs. 279-291)

**Resistance** is the property of a substance that hinders the movement (motion) of electric charge and converts electrical energy into other forms of energy. Use a diagram to illustrate what you understand about this statement.

According to Georg Simon Ohm, what is the relationship between current, voltage and resistance, and how can it be calculated?

In what applications are variable resistors used?
Illustrate a **series circuit** and a **parallel circuit** using the following:

Power source – 4 cells  
Loads – 3 resistors (eg. buzzer, 2 lamps)  
As many switches as you think you need

<table>
<thead>
<tr>
<th>Series</th>
<th>Parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Series Circuit Diagram" /></td>
<td><img src="image2" alt="Parallel Circuit Diagram" /></td>
</tr>
</tbody>
</table>

What is a potential problem with a parallel circuit in your house, and what is used to prevent it from happening?

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What are the factors and that affect resistance of wire, and how does each factor affect resistance?

<table>
<thead>
<tr>
<th>Factor</th>
<th>Effect</th>
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</tbody>
</table>
What is energy?

Complete the table that shows energy conversions related to electricity

<table>
<thead>
<tr>
<th>Device</th>
<th>Type of Energy Used</th>
<th>Type of energy converted to</th>
</tr>
</thead>
<tbody>
<tr>
<td>thermopile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>piezoelectric crystal</td>
<td></td>
<td></td>
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<tr>
<td>piezoelectric crystal</td>
<td></td>
<td></td>
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<tr>
<td>LED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>photovoltaic cell</td>
<td></td>
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<tr>
<td>electroplaques</td>
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</tr>
</tbody>
</table>

Describe how a thermocouple is made, what energy transformation occurs when it is used and how it works.

What is the ‘piezoelectric effect’?

What process/device enables a solar cell to transform the Sun’s energy into useable electricity?
**Topic 5 (pgs. 300-307)**

What did Luigi Galvini discover and what importance did it have for the science of physics?

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_______________________________________________________________________________

What are ‘voltaic piles’?

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Illustrate the difference between a **Wet Cell** and a **Dry Cell**.

<table>
<thead>
<tr>
<th>Wet Cell</th>
<th>Dry Cell</th>
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<tbody>
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</tbody>
</table>

Explain the difference between a **primary cell** and a **secondary cell**. Give two examples of each and what devices would use them.

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Describe how a device, such as a **generator**, converts mechanical energy into electrical energy.

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How is an **electromagnet** constructed?

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Explain the difference between **AC** and **DC current**.

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Illustrate a **DC Generator** and a **DC Motor**

<table>
<thead>
<tr>
<th>DC Generator</th>
<th>DC Motor</th>
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</tbody>
</table>

How does an **AC Motor** differ from a DC Motor?

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Illustrate a **Simple Motor** you can make with common household materials.

Describe the **step-by-step procedure** and what you observed when it worked, or didn’t work (the **troubleshooting techniques** you used.

<table>
<thead>
<tr>
<th>Procedure Order</th>
<th>Description of what to do</th>
<th>What worked or didn’t and what you did about it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
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<td>Step 2</td>
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<td>Step 3</td>
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<td>Step 4</td>
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<td>Step 9</td>
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<tr>
<td>Step 10</td>
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</tbody>
</table>
**Topic 7** (pgs. 318-331)

Illustrate and label, with explanations, how power is transmitted from the generating power station to your home.

Describe what a **service panel** in your house is and what function it serves.

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Explain the different between a **fuse** and a **circuit breaker**.

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Add these appliances to each house circuit as directed and calculate what the current is. If the circuit is overloaded – color the circuit breaker RED.

### Electrical Appliances w/ Power Rating

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Power Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toaster</td>
<td>1200 W</td>
</tr>
<tr>
<td>Hair Dryer</td>
<td>960 W</td>
</tr>
<tr>
<td>Iron</td>
<td>1320 W</td>
</tr>
<tr>
<td>Lamp</td>
<td>60 W</td>
</tr>
</tbody>
</table>

### Situation 1 – Mom is making toast for breakfast and Sandy is drying her hair

**Total Current Situation 1**

### Situation 2 – Dad is ironing his shirt, while he turns on the lamp to see better and Mom is drying her hair

**Total Current Situation 2**

### Situation 3 – The toaster is plugged in, the iron is warming up and Mom has just turned on the lamp in the bedroom

**Total Current Situation 3**

### Situation 4 – Mom is ironing her shirt, Sam has turned the lamp off, Dad is making toast and Sandy is re-drying her hair with her own hairdryer

**Total Current Situation 4**
What are **transistors** used as and in what devices are they commonly found?

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Complete the **Power Problems** (Show your work)

**Formula**

1. What is the Power (watts and kilowatts) of a hair dryer that requires 8 A of **current** on a 240 V circuit?
   
   **Solution:**

2. A 850 W oven requires a 7A current. What is the **voltage**?
   
   **Solution:**

3. A flashlight uses 2 1.5 V D-cells to light a bulb that can work on a current up to 0.5A. What is the maximum **Power** of the bulb?
   
   **Solution:**

Complete the **Electrical Costs Problems** (Show your work)

**Formula:**

Cost = usage X time

**Direct Energy**

Charges

$0.11$ per kWh for energy usage

1. You go around your house and find out there are 35 lights (60W each) in your house. If they all are on for about 5 hours every day. What does it cost your parents for 1 year?
   
   **Solution:**

2. Your stereo is on 4 hours every day. It operates on 120V, using 4A of current. How much does it cost your parents for 1 year?
   
   **Solution:**
Explain what this illustration means, and how does it help the consumer?

**ENERGUIDE Label**

<table>
<thead>
<tr>
<th>Explanation</th>
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</table>

How is the **efficiency** of a light bulb determined mathematically?

**Formula**

**Explanation:**

<table>
<thead>
<tr>
<th>Explanation</th>
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</tbody>
</table>

What are the advantages and disadvantages of different light bulbs?

<table>
<thead>
<tr>
<th>Type</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halogen</td>
<td></td>
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<tr>
<td>Fluorescent</td>
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</tbody>
</table>
Calculate the efficiency of an 800W kettle that takes 6 min to boil water. To heat the water to boiling point, it takes 200,000 J of energy. What is the efficiency of the kettle?

Show your work

Explanation of how efficient the kettle is:

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Identify the safety measure not being followed in each illustration, and identify what should be done to make it safer.

<table>
<thead>
<tr>
<th>Illustration</th>
<th>What’s Unsafe?</th>
<th>What should be done to make it safer?</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

What are four simple rules to follow, to protect yourself against fatal electrical shock, from electrical hazards outdoors?

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Topic 8 (pgs. 332-342)

Describe the process of electrical generation from the burning of coal.

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Using the Map and Graphic information on p. 333 in your Science Focus 9 Textbook to create a graph of those regions that produce in excess of 1000 GW*h shown using the following different colored bars on the graph:

- Total electricity production (red)
- Electricity from thermo-electric sources (green)
- Electricity from hydro-electric sources (blue)
- Electricity from nuclear sources (yellow)

Title ________________________________
What consequences – affecting Land and Air - result from the use of Fossil Fuels to generate electricity?

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How can gravity produce electricity? (Think about flowing water)

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How is electricity generated in Nuclear Reactors?

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What is **thermal pollution**?

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What is **cogeneration**?

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Complete the table

<table>
<thead>
<tr>
<th>Alternative Energy Source</th>
<th>Advantages</th>
<th>Disadvantages</th>
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</thead>
<tbody>
<tr>
<td>Wind</td>
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<tr>
<td>Solar</td>
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<tr>
<td>Tides</td>
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<td></td>
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<tr>
<td>Geothermal</td>
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</tbody>
</table>